EFFECT OF DEPRESSION LEVELS ON NEUROPSYCHOLOGICAL FUNCTIONS OF STROKE PATIENTS

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Abstract- The study is investigating the neuropsychological deficits in such patients to quantify the incidence of cognitive impairment, cerebrovascular risk factors, previous strokes, neurological conditions, and neuroimaging patterns as well as behavioral and psychological aspects. Current study is exploring the interconnection and causal relationship between the depression and neuropsychological functions of the stroke patients. This study has been approved by the Human ethics committee of hosted institution. The study has adopted experimental clinical research the subject is 75 stroke patients from 20 to 70 year old. While hospitalized, all the patients underwent a daily clinical examination and detected etiopathogenetic causes of stroke. After a 1 - 6 month period after stroke onset, all the patients completed NIMHANS Neuropsychological Battery by Shobini L. Rao, et.al. For the assessments of depression aspects we have used the tool Beck Depression Inventory (Beck, 1966). Results found that the there is no significance difference between Neuropsychological functions and levels of depression of stroke patients.
Keywords: Neuropsychological functions, Depression, stroke patients and Adults

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INTRODUCTION

Stroke is defined as "a syndrome of rapidly developing symptoms and signs of focal, and at times global, loss of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than that of vascular origin" (World Health Organization, 1988). The most beneficial factor of neuropsychological assessment is that it provides an accurate diagnosis of the disorder for the patient when it is unclear to the psychologist what exactly he/she has. This allows for accurate treatment later on in the process because treatment is driven by the exact symptoms of the disorder and how a specific patient may react to different treatments. The assessment allows the psychologist and patient to understand the severity of the deficit and to allow better decision-making by both parties. It is also helpful in understanding deteriorating diseases because the patient can be assessed multiple times to see how the disorder is progressing. Neuropsychological functions are attention and concentration; motor speed; executive functions such as planning ability, category fluency, phonemic fluency, working memory, set shifting and response inhibition, verbal learning and memory; visual learning and memory; expressive and receptive speech; visuo-constructive ability; and focal signs.

World Health Organization defined "Depression is a common mental disorder, characterized by persistent sadness and a loss of interest in activities that you normally enjoy, accompanied by an inability to carry out daily activities, for at least two weeks". Depressive disorders often follow a stroke. The reported prevalence vary widely from less than 25%' to more than 60% depending on the selection of patients, the time elapsed since the stroke, and different diagnostic criteria. Numerous studies, recently summarized,(House, 1987;Starkstein SE, et.al., 1989) have given conflicting information not only on prevalence but also on pathogenesis and course of the depressive disorders after stroke. The disorder has been explained as an understandable response of patients to their losses (Binder 1984). From a neurobiological viewpoint, the importance of lesion location has been emphasized (Robinson RG, et.al,1981; Robinson RG,et.al, 1982; House A, 1990).The contributions of physical impairment and psychosocial factors to depression after stroke are less well known and probably change overtime. Robinson RG,et.al, 1982; Parikh RM, 1987).

METHOD

Research design: This study is adopted cross sectional research design. Method of sampling was purposive sampling. Scoring was done as per manuals of the NIMHANS neuropsychological battery and psychological tests used. SPSS was employed for statistical analyses.

Sampling: The sample consisted of 75 patients, with 1 to 6 month episode of post – stroke, diagnosed by neurologists from Chettinad Super specialty Hospital which have Neurology and Neuro – surgery departments. This study was obtained informed consent from respective samples.
Inclusion criteria: Age between 20 – 70, Handedness: Right handed, Handedness: Left handed, Established Cerebrovascular disease after 1 month, Patients with Aphasia and Gender: Male and Female.
Exclusion criteria: Liver dysfunction, Major psychiatric problems, Clinical evidence of mental retardation, Kidney dysfunction and Degenerative dementia.

Tools: NIMHANS Neuropsychological Battery – Rao, Subbakrishna, and Gopukumar (2004) and Beck Depression Inventory (Beck, 1966).
Statistical tools used: Descriptive statistics, Cluster Analysis and Multiple Analysis of Variance (MANOVA).

RESULTS AND DISCUSSIONS

On the basis of homogeneity of responses to depression, the respondents were divided into two clusters using k-means cluster. The clusters were formed only on the basis of their self-reporting scores on Depression. They are labeled as 1) High depression fit and 2) Low depression fit stroke patients.

Table 1
Cluster Classification

Clusters denotes depression levels		
Cluster	1	37.000
groups	2	38.000
		75.000

It is found that 37 respondents are low in depression fit and 38 in high depression fit. The following is the level of depression fit on all the 21 items that constitute the composite Depression factor.

Table 2
Composite depression Factor

	Depression Groups								
	Low Depression			High Depression			Total		
	Mean	n	SD	Mean	n	SD	Mean	n	SD
Depression Question 1(DQ1)	1.6216	37	1.11433	1.6842	38	1.11756	1.6533	75	1.10885
Depression Question 2(DQ2)	2.0000	37	1.02740	1.2895	38	.95600	1.6400	75	1.04804
Depression Question 3(DQ3)	.6486	37	.78938	2.0263	38	.88491	1.3467	75	1.08420
Depression Question 4(DQ4)	.8649	37	.94757	2.2368	38	.88330	1.5600	75	1.14183
Depression Question 5(DQ5)	1.2432	37	1.01120	1.8684	38	.96341	1.5600	75	1.02983
Depression Question 6(DQ6)	1.6757	37	1.17978	1.8158	38	1.03598	1.7467	75	1.10397
Depression Question 7(DQ7)	1.2973	37	1.05053	1.4211	38	1.08133	1.3600	75	1.06085
Depression Question 8(DQ8)	1.5135	37	1.04407	1.6579	38	1.09733	1.5867	75	1.06661
Depression Question 9(DQ9)	1.4865	37	1.14556	1.7368	38	1.17828	1.6133	75	1.16124
Depression 10(DQ10)	1.1892	37	1.10146	1.4474	38	1.08297	1.3200	75	1.09248
Depression 11(DQ11)	1.5946	37	1.06613	1.9211	38	1.12422	1.7600	75	1.10086
Depression 12(DQ12)	1.6757	37	1.20310	1.9474	38	1.01202	1.8133	75	1.11129
Depression 13(DQ13)	2.1081	37	1.04838	1.6053	38	1.10379	1.8533	75	1.09906
Depression 14(DQ14)	1.2432	37	1.03831	1.9474	38	1.18430	1.6000	75	1.16248
Depression 15(DQ15)	1.8108	37	1.19810	1.2895	38	1.06309	1.5467	75	1.15423
Depression 16(DQ16)	1.0811	37	1.01046	1.6579	38	1.27928	1.3733	75	1.18291
Depression 17(DQ17)	1.5405	37	1.06965	1.6842	38	1.18790	1.6133	75	1.12578
Depression 18(DQ18)	1.7027	37	1.10214	1.4211	38	1.08133	1.5600	75	1.09347
Depression 19(DQ19)	1.4324	37	1.21428	1.7632	38	1.14925	1.6000	75	1.18550
Depression 20(DQ20)	1.8108	37	.99549	1.7105	38	1.20602	1.7600	75	1.10086
Depression 21(DQ21)	1.4595	37	1.09531	1.7368	38	1.10733	1.6000	75	1.10282

It has been found that the depression mean score on the first item (item named: DQ1) is 1.6216 in the group 1 and 1.6842 in the group 2, which indicates that the depression level is high in the group 2 cluster and low on the group 1 cluster. Similarly, the mean depression score on item 2 (DQ2) in the first cluster is 2.0000 and cluster 2 is 1.2895. The depression mean score of the item 3 (DQ3) is 0.6486 on the group 1 and 2.0263 on the group 1 cluster. Depression level of item 4 (DQ4) mean score is 0.8649 in the group 1 and 2.2368 in the group 2. The depression mean scores are following item wise, in the item 5 (DQ5) is 1.2432 in the group 1 and 1.8684 in the group 2, item 6 (DQ6) group 1 is 1.6757 and group 2 is 1.8158, item 7 (DQ7) group 1 is 1.2973 and group 2 is 1.4211, item 8 (DQ8) group 1 is 1.5135 and group 2 is 1.6579, item 9 (DQ9) group is 1.4865 and group 2 is 1.7368, item 10 (DQ10) group 1 is 1.1892 and group 2 is 1.4474, item 11 (DQ11) group 1 is 1.5946 and group 2 is 1.9211, item 12 (DQ12) group 1 is 1.6757 and group 2 is 1.9474, item 13 (DQ13) group 1 is 2.1081 group 2 is 1.6053, item 14 (DQ14) group 1 is 1.2432 and group 2 is 1.9474, item 15 (DQ15) group 1 is 1.8108 and group 2 is 1.2895, item 16 (DQ16) group 1 is 1.0811 and group 2 is 1.6579, item 17 (DQ17) group 1 is 1.5405 and group 2 is 1.6842, item 18 (DQ18) group 1 is 1.7027 and group 2 is 1.4211, item 19 (DQ19) group 1 is 1.4324 and group 2 is 1.7632, item 20 (DQ20) group 1 is 1.8108 and group 2 is 1.7105 and the item 21 (DQ21) mean score is 1.4595 in the group 1 cluster and 1.7368 in the group 2 cluster. Based on the score on each depression item, the members in the first group could be termed as "Low Depression group" and those in the second group could be "High Depression group".

Tests of significance difference across the high and low depression groups on neuropsychological functions

The Neuropsychological functions consists of several test that includes Motor Speed, Design Fluency, Attention, Verbal Fluency, Planning, Working Memory, Verbal Comprehension, Response Inhibition, Verbal Learning and Memory, Category Fluency, Visuo-Spatial Construction, Visual Learning and Memory and Set Shifting.

In order to test for significance difference across the high and low depression groups, Multivariate Analysis of Variance (MANOVA) has been used in order to ascertain the main and interactive effects of the independent variables on the multiple dependent variables as well as the significance of the dependent variables and the strength of association between dependent variables.
The MANOVA model that was developed by the researcher is given below

Depression groups entered the MANOVA model as fixed factors, and Neuropsychological functions entered as dependent variables. In this research, neuropsychological functions were measured as a construct that include the above neuropsychological functions. The dependent variables entered the MANOVA model are the exact scores of the individual neuropsychological items that captured the larger construct called the neuropsychological functions.

In the MANOVA has consists of various statistical test to assess the variables namely, Roy's Greatest Root, Wilk's Lambda λ, Pillai's trace, Hotelling-Lawley's trace, each with its own associated *F* statistic. Hotelling's Trace is universal and classical test, where the fixed factor is formed of two groups. It is found that the F statistic produced is not significant at 0.05 or 0.1 level for both depression categories. Therefore, the researcher concludes that there exists no main effect on the neuropsychological function. Also, neuropsychological functions of the stroke patients do not differ significantly across the depression groups. However, test of between subjects were examined to determine if there is individual effects on neuropsychological functions. The results are presented below in table 3.

Table 3
Neuropsychological functions and Depression groups

Source	Dependent Variable	F	Sig.
Corrected Model	Motor Speed: Finger Tapping Test	1.102	.297
	Mental Speed: Digit Symbol Substitution Test (Total Time)	.009	.926
	Focused Attention: Color trail1 – Total time	5.412	.023
	Focused Attention: Color trail 2 – Total time	.250	.618
	Sustained Attention: Digit vigilance – Total time	.431	.513

Sustained Attention: Digit vigilance – Number of errors	.357	.552
Divided Attention: Triads – Total number of error	1.414	.238
Verbal Fluency: COWAT- ANW	.068	.794
Category Fluency: ANT - TNW	1.332	.252
Design Fluency: Free Condition - Total New Designs	.636	.428
Design Fluency: Fixed Condition Total New Designs	4.624	.035
Working Memory: VNBT- 1 BH	.074	.787
Working Memory: VNBT- 1 BE	.253	.617
Working Memory: VNBT- 2 BH	.975	.327
Working Memory: VNBT- 2 BE	.075	.785
Working Memory: Visual NBTest - 1 BH	.073	.787
Working Memory: Visual NBTest - 1 BE	.610	.437
Working Memory: Visual NBTest - 2 BH	.461	.499
Working Memory: Visual NBTest - 2 BE	.544	.463
Working Memory: SOPT-TWE	1.172	.282
Working Memory: SOPT -TPE	.025	.875
Planning: Tower of London Test (TL) 2 Moves - Mean Time	.004	.951
Planning: Tower of London Test (TL) 2 Moves - Mean Moves	.624	.432
Planning: Tower of London Test (TL) 2 Moves - NPSWMM	.001	.977
Planning: Tower of London Test (TL)3 Moves - Mean Time	.535	.467
Planning: Tower of London Test (TL) 3 Moves - Mean Moves	.923	.340
Planning: Tower of London Test (TL) 3 Moves - NPSWMM	4.784	.032
Planning: Tower of London Test (TL) 4 Moves - Mean Time	5.177	.026
Planning: Tower of London Test (TL) 4 Moves - Mean Moves	.650	.423
Planning: Tower of London Test (TL) 4 Moves - NPSWMM	3.573	.063
Planning: Tower of London Test (TL) 5 Moves - Mean Time	.031	.861
Planning: Tower of London Test (TL) 5 Moves - Mean Moves	.015	.903
Planning: Tower of London Test (TL) 5 Moves - NPSWMM	.687	.410
Response Inhibition: Stroop Test	2.450	.122
Verbal Comprehension: Token test	.396	.531
Verbal Learning and Memory (VLM): AVLT - T1 NC	.000	.997
VLM: AVLT -Trial 2 Number of correct	.111	.740
VLM: AVLT -Trial 3 Number of correct	1.069	.305
VLM: AVLT -Trial 4 Number of correct	.129	.721
VLM: AVLT -Trial 5 Number of correct	.757	.387
VLM: AVLT -Total Number of Correct	.955	.332
VLM: AVLT -List B Number of Correct	.060	.807
VLM: AVLT -Immediate Recall Number Correct	.097	.756
VLM: AVLT - Delayed Recall Number Correct	.023	.881
VLM: AVLT - Long Term Percent Retention	1.147	.288
VLM: AVLT - Number of Hits	.940	.335
VLM: Passage Test - Logical Memory(LM) - IRNC	1.028	.314
VLM: Passage Test: Logical Memory(LM) - DRNC	7.555	.008
Visuospatial Construction: Complex Figure Test(CFT) - Copying	.690	.409
Visual Learning and Memory (Visual LM): Complex Figure Test(CFT) - Immediate Recall (IR)	.471	.495
Visual LM: Complex Figure Test(CFT) - Delayed Recall	.001	.977
Visual Learning and Memory (Visual LM): Design Learning Test(DLT) - Trial 1 Number of correct	1.183	.280
Visual LM: DLT -Trial 2 Number of correct	.356	.553
Visual LM: DLT -Trial 3 Number of correct	1.715	.194
Visual LM: DLT -Trial 4 Number of correct	.994	.322
Visual LM: DLT -Delayed Recall	.312	.578
Set Shifting: Wisconsin Card Sorting Test(WCST) - Number of Trails	.017	.896
Set Shifting: WCST - Number of Correct Responses	.001	.974

Set Shifting: WCST - Number of Errors	1.813	.182
Set Shifting: WCST - Percentage of Errors	.285	.595
Set Shifting: WCST - Perservative Responses(PR)	.973	.327
Set Shifting: WCST - Percentage of Perservative Responses	.024	.878
Set Shifting: WCST - Perservative Errors	.396	.531
Set Shifting: WCST - Percentage of Perservative Errors	.111	.740
Set Shifting: WCST - Non Perservative Errors	5.609	.021
Set Shifting: WCST - Percentage of Non Perservative Errors	.280	.598
Set Shifting: WCST - Conceptual Level Responses	.587	.446
Set Shifting: WCST - Percentage of Conceptual Level Responses	.004	.947
Set Shifting: WCST - Number of Categories Completed	.600	.441
Set Shifting: WCST -Trails to Complete Category	1.043	.310
Set Shifting: WCST - Failure to Maintain Set	3.518	.065

**significance value = 0.05 level*

The above table suggests that the difference across depression groups (F=5.412; p=0.023) on focused attention color trail 1 test. Significant difference found in the Design Fluency, Fixed Condition - Total New Designs (F=4.624; p=0 .035) Similarly, difference exists across planning Tower of London test, 3 moves – NPSMM (F=4.784; p=0.032), 4 moves - mean time (F=5.177; p=0.026), In the part of verbal LM across the logical memory – Delayed recall number correct (F=7.555; P=0.008) and also found a significant difference the domain of set shifting based on the WCST – non perservative errors (F=5.609; p=0.021).
On examination of the descriptive tables, it is found that neuropsychological function represented by the variable focused attention color trail 1 test is high across the low depression groups (Mean = 9.87).Design Fluency, Fixed Condition - Total New Designs is high across the low depression groups (Mean = 13.29). Variable of planning in Tower of London test, 3 moves - NPSMM is high across the low depression groups (Mean = 17.82), 4 moves - mean time is high across the low depression groups (Mean = 14.84) and 4 moves - mean moves is high across the high depression groups (Mean = 13.62). In the domain of verbal LM across the logical memory – Delayed recall number correct is high across the high depression groups (Mean = 20.81) and the variable Set Shifting WCST, non Perservative errors is high across the low depression groups (Mean = 15.89) compare to the low depression groups. It is found that there is no main effect of other neuropsychological functions and depression level of stroke patients. This finding is consistent with previous research which showed that depression is associated with an increased in cognitive impairment among stroke survivors (Austin, Mitchell & Goodwin, 2001). This finding supported the hypothesis of this research in which it was hypothesized that depressed patient would experience more cognitive impairment than those who are not.

Feibel and Springer (1982) related depression to the loss of social activities after stroke. Robinson RG, et a1. (2008) found that the location of the lesion was significant, with patients with anterior left hemisphere lesions more likely to be depressed. Wade et al.(2002) concluded that factors associated with depression included the loss of functional independence, a low level of social activities, a low IQ and being female. They also found that most depression could not be explained on the basis of these associated variables which seemed to imply that preexisting personal characteristics probably have an important influence upon the presence of depression after stroke.

Conclusion

Therefore, the researcher concludes that there exists no main effect on the neuropsychological function. Also, neuropsychological functions of the stroke patients do not differ significantly across the depression groups. Study on predictors of post stroke cognitive impairment showed that general health status and depression was a predictor of cognitive impairment. Those who were depressed were associated with cognitive impairment. This finding agrees with previous research stated that depressed patients have been more cognitively impaired (Anderson et al., 2005; House et al.,1990; Sharp et al.,1994).

Conflict of Interest: There is no conflict of interest.

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